Final Report
Synchrotron Self-Compton Models for Superluminal Radio Sources, Periodic Variability and Complex Absorption in the Seyfert Galaxy NGC6814, and Soft X-Ray Properties of a Complete Radio-Selected Sample of BL Lacertae Objects
NASA Grant NAG5-1918

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This is a final report to the National Aeronautics and Space Administration (NASA) concerning NASA grant NAG5-1918. This grant was awarded to Dr. C. Megan Urry of the Space Telescope Science Institute in response to successful Rosat proposals to study "Synchrotron Self-Compton Models for Superluminal Radio Sources," "Periodic Variability and Complex Absorption in the Seyfert Galaxy NGC6814," and "Soft X-Ray Properties of a Complete Radio-Selected Sample of BL Lacertae Objects." Some of the work on this project was carried out by a graduate student, Rita Sambruna (now at Goddard Space Flight Center); a post-doc, Joe Pesce (at STScI); a data analyst, Diane Gilmore; and an STScI summer student (Abby Paske).

The grant was originally awarded on 3/4/92, with additional awards on 3/22/93 and 12/29/93; this report covers the period through February 1996.

We have made considerable progress on our project to understand the X-ray properties of radio-selected BL Lacs. A large number of papers have been published or accepted for publication, including:

- "X-Ray Properties of a Complete Sample of Radio-Selected BL Lacertae Objects"

1996, C. M. Urry, R. M. Sambruna, D. M. Worrall, R. I. Kollgaard, E. Feigelson, E. S. Perlman, and J. T. Stocke, ApJ, 463, in press

- "On the Spectral Energy Distributions of Blazars" 1996, R. M. Sambruna, L. Maraschi, and C. M. Urry, ApJ, 463, in press
- "Spectral Variability of the X-ray Bright BL Lacertae Object PKS 2005-489" R. M. Sambruna, C. M. Urry, G. Ghisellini, and L. Maraschi, 1995, ApJ, 449, 567-575
- "Inverse-Compton X-Rays from the Quasar 3C 345" S. C. Unwin, A. E. Wehrle, C. M. Urry, D. M. Gilmore, E. J. Barton, B. C. Kjerulf, J. A. Zensus, and C. Rabaca, 1994, ApJ, 432, 103

In addition, my post-doc, Joe Pesce, has published work on a related topic completed while he was partially funded under this grant:

- "Redshifts of Southern Radio Galaxies" 1995, R. Scarpa, R. Falomo, and J. E. Pesce, A&A, in press
- "Host galaxy and environment of the BL Lacertae Object PKS 0548–322: Observations with subarcsecond resolution" 1995, R. Falomo, J. E. Pesce, and A. Treves, ApJ, 438, L9
- "Environmental Properties of BL LAC Objects" 1995, J. E. Pesce, R. Falomo, and A. Treves, AJ, 110, 1554

The following invited review papers and/or book chapters were based in part on work supported by this grant:

- "Blazars, the Most Violent Active Galaxies" C. M. Urry, 1996, AAAS Annual Meeting and Science Innovation Exposition, 162nd National Meeting of the AAAS, ed. Michael S. Strauss, et al., p. S-48
- " An Overview of Blazar Variability" C. M. Urry, 1996, in *Blazar Variability*, (Proc. Conference in Miami, February 1996), ed. J. Webb, in press
- "Jets in Active Galactic Nuclei" C. M. Urry, 1993, in *Frontiers of Space and Ground-based Astronomy*, ed. W. Wamsteker, M. S. Longair, and Y. Kondo, (Dordrecht: Kluwer), p. 335
- "Multiwavelength Monitoring of Active Galactic Nuclei" C. M. Urry,1993, Adv. Space Res., 13, 573

Finally, the following papers have been presented at or submitted for conferences:

- "The Broad Band Energy Distributions of a Complete Sample of Radio-selected BL Lacertae Objects" R. M. Sambruna, C. M. Urry, L. Maraschi, and G. Ghisellini, 1995, BAAS, 26, 1466

- "Rosat Observations of a Complete Sample of Radio-Selected BL Lacertae Objects" C. M. Urry, R. M. Sambruna, J. Stocke, E. Perlman, R. Kollgaard, E. Feigelson, D. Worrall, and P. Padovani, 1994, in *The Multi-Mission Perspective* (High Energy Astrophysics Division Meeting of the American Astronomical Society, Napa Valley, November 1994), p. 105

- "The Multifrequency Spectra of Blazars" R. M. Sambruna, C. M. Urry, L. Maraschi, and G. Ghisellini, 1994, in *The Multi-Mission Perspective* (High Energy Astrophysics Division Meeting of the American Astronomical Society, Napa Valley, November 1994), p. 106

- "Inverse-Compton X-Rays from the Quasar 3C 345" S. C. Unwin, A. E. Wehrle, C. M. Urry, E. J. Barton, B. C. Kjerulf, J. A. Zensus, and C. Rabaca, 1993, BAAS, 25, 791

- "ROSAT PSPC Observations of Radio-Selected BL Lac Objects" R. M. Sambruna, C. M. Urry, J. Stocke, E. Perlman, R. Kollgaard, E. Feigelson, D. Worrall, P. Padovani, L. Maraschi, and A. Treves, 1993, BAAS, 25, 1449

- "X-Rays and Relativistic Beaming in Radio-Selected BL Lacertae Objects" R. I. Kollgaard, E. D. Feigelson, D. C. Gabuzda, R. Sambruna, and C. M. Urry, 1993, BAAS, 25, 1449

- "PSPC Observations of the 1 Jy BL Lacs" R. M. Sambruna, C. M. Urry, J. Stocke, E. Perlman, R. Kollgaard, E. Feigelson, D. Worrall, P. Padovani, L. Maraschi, and A. Treves, 1993, in *The Soft X-Ray Cosmos*, ed. E. M. Schlegel and R. Petre, (College Park: AIP Conf. Proc. 313), p. 415

- "X-Rays and Relativistic Beaming in Radio-selected BL Lacertae Objects" R. I. Kollgaard, E. D. Feigelson, D. C. Gabuzda, R. M. Sambruna, and C. M. Urry, 1993, in *The Soft X-Ray Cosmos*, ed. E. M. Schlegel and R. Petre, (College Park: AIP Conf. Proc. 313), p. 420

Funds from this grant have been used to support the salaries of a post-doc, graduate student, summer student, and data analyst, as well as travel to two scientific conferences to present results as listed above. This work has now been completed. We anticipate one further paper interpreting individual spectra in terms of inhomogeneous jet models, and will support the additional page charges through some other means.